UNIVERSITY OF CALGARY

FACULTY OF ARTS
Department of Philosophy

PHIL 579.02 L01 — "Advanced Topics in Logic: Modal Logic"
Winter Term 2018

Course Outline

Lectures: M 15:00–17:45, Social Sciences 1253

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Office Hours: M 13:00–15:00, or by appointment

Course Description

Modal logic is an extension of ordinary, "classical" logic which allows formalizations (for instance) of phrases such as "it is possible that" and "it is necessary that" (the alethic modalities). Modal logics have important applications in philosophy, but also in linguistics and computer science. The course will provide an introduction to the basics of modal logic, especially their semantics, axiomatization, and proof theory. We will also cover various specific systems and their applications. Example systems include the alethic modalities, logics of belief and knowledge, of time, of agents and change, combinations thereof (e.g., dynamic epistemic logic), as well as related topics such as logics of counterfactual conditionals and intuitionistic logic—the particular choice of topics will depend on the interests of the class.

Prerequisites

Phil 279 (Logic I) is a prerequisite for this course.

Course Learning Outcomes

By the end of the course, you will be able to . . .
1. articulate and explain the semantics for modal and related logics using relational models, construct such models, and reason about them;

2. articulate and explain the relation between systems of modal logic with certain axioms and the properties of frames these axioms characterize, and prove completeness of modal logics relative to frames with these properties;

3. articulate, reason about, connect, and apply various model-theoretic properties and constructions on relational models such as bisimulations, unraveling, and bulldozing;

4. construct derivations in one or more proof systems for modal logics;

5. use the formal models for modal and related logics in applications in philosophy and other areas;

6. research systems of modal logic, their metatheory, and their application and philosophical significance independently, and present them in clear, well-structured written prose as well as orally.

Required Text

Readings will be made available electronically via D2L.

The following books are useful sources:

Johan van Benthem, *Modal Logic for Open Minds*. (CSLI Publications, 2010)

Patrick Blackburn, Johan Van Benthem and Frank Wolter, *Handbook of Modal Logic* (Elsevier, 2007) – available online.

Patrick Blackburn, Maarten de Rijke, Yde Venema, *Modal Logic* (Cambridge University Press, 2002)

Melvin Fitting, Eliott Mendelsohn, *First-order Modal Logic* (Springer, 1998)

James Garson, *Modal Logic for Philosophers* (Cambridge University Press, 2013)

Course Assessment

Your grade will be determined on the basis of three problem sets (60%, 20% each) and a final project and presentation (40%, of which 5% is for a draft and bibliography, 5% for the presentation, and 30% for the final product).

There will be no exams. You must submit all three assignments and the final project to pass the course. The quality (correctness, concision, clarity) of your writing is a factor in the evaluation of your work.

The final project will consist in a paper (at least 3,000 and not more than 5,000 words, excluding bibliography) on a topic of your choice related to the material covered in the course. You will give an oral presentation on your paper in the penultimate week of class. Possible projects include: a proof of a theorem in the metatheory of modal logic, a survey article on some application of modal logic in computer science, logic, or linguistics, or a philosophical paper on a topic related to modal logic. The amount and quality of independent research on your part (or lack thereof) will be taken into account in assigning a grade. You may complete the project alone, in pairs. In the latter case, the minimum length of the paper is 4,000 words.

For each problem set and for the final project components, you will receive a letter grade (possibly with +'s or −'s) reflecting the level of mastery of the material shown by the work you submit. The overall grading rubric is given below:

A Excellent—superior performance, showing comprehensive understanding of subject matter.

Your work shows comprehensive understanding of the subject matter. Your solutions to problems are correct, clear, and elegant. Your final project presents a well-researched, non-trivial topic in a correct, clear, well-organized, self-contained, and accessible paper.

B Good—clearly above average performance with knowledge of subject matter generally complete.

Your work shows a complete understanding of most topics covered in the course. Your solutions to problems are mostly correct, with only minor errors or oversights, and reasonably clear. Your final project presents a relevant topic in a well-organized paper with coverage of the topic reasonably complete and no significant errors or areas of unclarity.

C Satisfactory—basic understanding of the subject matter.

Your work shows only a basic understanding of the topics covered in the course. You can only complete simple problems correctly but proofs contain major errors. Your final project is relevant and contains some interesting and correct contributions but may be insubstantial, unclear, disorganized, or contain major errors.

D Minimal pass—marginal performance.

You complete most assignments but your solutions are unclear, incorrect, or incomplete. You have trouble completing even simple problems. Your final project is badly organized, unclear, incorrect, or superficial.

F Fail—Unsatisfactory performance.

In computing your final grade, your marks will be converted to grade points (A = 4, B = 3, C = 2, D = 1, F = 0, with +/− adding/subtracting 0.3), and averaged according to the weights given above. The final mark is the letter grade corresponding to this average plus a margin of 0.1 (i.e., an average of 3.9 earns an A, an average of 3.6 an A−, etc.).

Assignments and Policies

Tentative due dates. Problem sets will be due on January 29, February 26, and March 19, at 15:00 (beginning of class). The draft of the final project is due March 26 at 15:00 and the final project is due April 13, end of day.

Submitting assignments. You may submit problem sets in class or in the Phil 579 dropbox in the corridor outside SS 1253 in the Philosophy Department.

Late work. You may turn in one problem set, the project draft, or the final project 48 hours past the deadline without penalty, but you must tell me by email before the deadline. Late submissions beyond this one late assignment will be penalized by the equivalent of one grade point per calendar day or part thereof (unless you can document an illness or other emergency which prevented you from completing or submitting the assignment).

Collaboration. Collaboration on problem sets is encouraged. However, you must write up your own solutions, and obviously you must not simply copy someone else's solutions. You are also required to list the names of the students with whom you've collaborated on the problem set. **If you collaborate without following these instructions**, **it constitutes cheating**.

Plagiarism. You might think that it's only plagiarism if you copy a term paper off the internet. However, you can also plagiarize in a logic course, e.g., by copying a proof verbatim from the textbook or the internet (and only making the necessary changes to apply it to the assigned problem.) The point of logic problems which are similar to the proofs in the text is to make you work through those proofs, understand them, and then prove a similar result on the problem sets. Hence, all solutions must be in your own words; copying or paraphrasing closely from the text or elsewhere constitues plagiarism, which must be reported to the Dean's office by university policy. It may result in a failing grade or worse penalties.

Checking your grades and reappraisals of work. University policies for reappraisal of term work and final grades apply (see the *Calendar* section "Reappraisal of Grades and Non-Disciplinary Academic Appeals"). In particular, term work will only be reappraised within 15 calendar days of the date you are advised of your marks. Please keep track of your assignments (make sure to pick them up in lecture or in office hours) and your marks (check them on D2L) and compare them with the graded work returned to you.

Tentative Schedule and Due Dates (topics subject to change)

Week 1 (Jan 8). Introduction. Modal languages. Relational models.

Week 2 (Jan 15). Frames and models. Validity and consequence.

Week 3 (Jan 22). Axiom systems. Canonical models and completeness.

Week 4 (Jan 29). Model-theoretic constructions.

    Assignment 1 due

Week 5 (Feb 5). Finite models and decidability.

Week 6 (Feb 12). Proof systems for modal logics.

Week 7 (Feb 26). Intuitionistic logic.

    Assignment 2 due

Week 8 (Mar 5). First-order modal logic.

Week 9 (Mar 12). Counterfactual conditionals.

Week 10 (Mar 19). Epistemic logic.

    Assignment 3 due

Week 11 (Mar 26). Further topics.

    Draft final project due March 26

Week 12 (Apr 2). Further topics.

Week 13 (Apr 9). Student presentations.

    Final project due April 13

IMPORTANT DEPARTMENTAL, FACULTY AND UNIVERSITY INFORMATION

Academic Honesty
Cheating or plagiarism on any assignment or examination is regarded as an extremely serious academic offense, the penalty for which may be an F on the assignment, an F in the course, academic probation, or requirement to withdraw from the University. See the relevant sections on 'Academic Misconduct' in the current University Calendar. Intellectual honesty requires that your work include adequate referencing to sources. Plagiarism occurs when you do not acknowledge or correctly reference your sources. If you have questions about correct referencing, consult your instructor.

Academic Accommodation
The student accommodation policy can be found at: ucalgary.ca/access/accommodations/policy.

Students needing an Accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities http://www.ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf.

Students needing an Accommodation based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to their instructor.

D2L Help
Desire2Learn is UCalgary's online learning management system. Important information and communications about this course may be posted on D2L. Go to https://ucalgary.service-now.com/it for help.

Protection of Privacy
The University of Calgary is under the jurisdiction of the provincial Freedom of Information and Protection of Privacy (FOIP) Act. The Department of Philosophy ensures the student's right to privacy by requiring all graded assignments be returned to the student directly from the instructor or teaching assistant.

Internet and Electronic Communication Devices
The instructor reserves the right to establish course policies regarding the use of devices such as laptops, tablets, and smartbooks. If allowed, these devices must be used exclusively for instructional purposes and must not cause disruption to the instructor or to fellow students. Cell phones and paging devices should be set to silent mode during lectures. Audio or video recording of lectures is not permitted without the written permission of the instructor. Students violating this policy are subject to discipline under the University of Calgary's Non-Academic Misconduct policy

Emergency Evacuation:
In case of an emergency evacuation during class, students must gather at the designated assembly point nearest to the classroom. The list of assembly points is found at http://www.ucalgary.ca/emergencyplan/assemblypoints . Please check this website and note the nearest assembly point for this course.

Other Helpful Contacts
- Safewalk and Campus Security: 403-220-5333.
- Student Union: https://www.su.ucalgary.ca/; 403-220-6551.
- Student Ombuds' Office (ucalgary.ca/ombuds/) ombuds@ucalgary.ca
- Campus Mental Health Strategy: https://www.ucalgary.ca/mentalhealth/